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MFN 09-750 Docket No. 52-010

December 2, 2009

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application – Engineered Safety Systems – RAI Number 6.3-89**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to portion of the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by the Reference 1 NRC letter. GEH response to RAI Number 6.3-89 is addressed in Enclosure 1.

Enclosure 2 contains markups to DCD Tier 2 Section 6.3 as noted in the Enclosure 1 response.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-689, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application,* November 2, 2009

Enclosures:

1. MFN 09-750 - Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.3-89
2. MFN 09-750 - Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.3-89 – Markups to ESBWR DCD Tier 2 Section 6.3

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH (with enclosures)
	DH Hinds	GEH (with enclosures)
	SC Moen	GEH (w/o enclosures)
	eDRFsection	0000-0110-0741

Enclosure 1

MFN 09-750

Response to Portion of NRC Request for

Additional Information Letter No. 388

Related to ESBWR Design Certification Application

Engineered Safety Systems

RAI Number 6.3-89

NRC RAI 6.3-89

At the ACRS briefing on October 21, 2009, GEH described the design attributes, ITAAC, and in-service testing activities to provide assurance that the ESBWR Gravity-Driven Cooling System (GDCS) will provide adequate reactor core cooling flow in the event of a loss of coolant accident. The NRC staff requests that GEH revise the DCD to clarify that the GDCS injection and equalization lines will be designed to have a specific minimum slope as they approach the reactor pressure vessel to inhibit steam or non-condensable gases from entering the GDCS piping. In addition, GEH stated that the GDCS squib valves will have a sample of their initiators test-fired prior to initial plant operation to avoid potential common cause failure. Please include this requirement in the DCD.

GEH Response

Minimum slope requirements for GDCS injection and equalizing lines will be added to the DCD.

Pre-operational testing requirements for igniters and booster subassemblies for GDCS squib valves will be added to the DCD.

DCD Impact

DCD Tier 2, Subsections 6.3.2.7.2 and 6.3.2.7.4 will be revised as noted in the attached markup.

Enclosure 2

MFN 09-750

Response to Portion of NRC Request for

Additional Information Letter No. 388

Related to ESBWR Design Certification Application

Engineered Safety Features

RAI Number 6.3-89

Markups to ESBWR DCD Tier 2 Section 6.3

The GDCS is designed to mitigate the consequences of a hypothetical severe accident with molten core material on the lower DW floor. The lower DW basemat is divided into 30 cells, with two thermocouples (channels A and B) installed in each cell, to sense the presence of molten fuel on the lower DW floor. A temperature greater than the setpoint sensed by channel A thermocouples in any two adjacent cells, coincident with channel B thermocouples also sensing a temperature greater than the setpoint in any two adjacent cells, initiates deluge line flow. Inadvertent actuation is prevented by the presence of an inhibit signal if another set of dedicated safety-related thermocouples monitoring the lower DW temperature do not sense the temperature to be greater than a preset value. The initiation signal opens the deluge valve on each separate deluge line to allow GDCS pool water to drain to the lower DW. This water aids in cooling the molten core.

GDCS Injection and Equalizing Line Sloping

The GDCS injection lines downstream of the GDCS pools have a minimum downward slope of 1:48 (one unit of rise per 48 units of run) to each GDCS injection line squib valve. Downstream of each GDCS injection line squib valve, the lines have a minimum upward slope of 1:48 to each RPV injection line nozzle.

The GDCS equalizing lines downstream of the suppression pool have a minimum downward slope of 1:48 to each GDCS equalizing line squib valve. Downstream of each GDCS equalizing line squib valve, the lines have a minimum upward slope of 1:48 to each RPV equalizing line nozzle.

Equipment and Component Description

The following describes the GDCS squib valve, deluge valve and biased-open check valve, which are unique system components that are not used in previous BWR designs.

Squib Valve

The function of the squib valve is to open upon an externally applied signal and to remain in its full open position without any continuing external power source in order to admit reactor coolant makeup into the reactor pressure vessel in the event of a LOCA. The valves also function in the closed position to maintain RPV backflow leaktight and maintain reactor coolant pressure boundary during normal plant operation. The GDCS squib valves have a flow coefficient, C_v, that permits development of full GDCS flow. The valve is a horizontally mounted, straight through, long duration submersible, pyrotechnic actuated, non-reclosing valve with metal diaphragm seals and flanged ends. The valve design is such that no leakage is possible across the diaphragm seals throughout the 60 year life of the valve. The squib valve is classified as Quality Group A, Seismic Category I, and ASME Section III Class 1. The valve diaphragm forms part of the reactor pressure boundary and as such is designed for RPV service level conditions.

Valve actuation occurs via squib valve initiators, in which a pyrotechnic booster charge is ignited and hot gases are produced. The logic for initiation is described in Subsection 7.3.1.2.2. To minimize the probability of common mode failure, the injection line squib valve pyrotechnic booster charge is from a different batch than from the batch used in equalizing line squib valves.

- Seismic Category: I.

All piping and valves (including supports) connecting the GDCS pools and suppression pool to the check valve, and all piping and valves (including supports) connecting GDCS pools to the lower DW are classified as follows:

- Safety-Related,
- Quality Group: B, and
- Seismic Category: I.

The electrical design is classified safety-related.

6.3.2.7.4 Testing and Inspection Requirements

Performance Tests

During fabrication, the GDCS components are subjected to various tests and examinations as required by the ASME Code, including hydrostatic testing and operability testing.

The GDCS is tested for its operational ECCS function during the preoperational test program. Each component is tested for power source, range, setpoint, position indication, etc.

All GDCS logic elements are tested individually and then as a system to verify complete system response to a sustained RPV Level 1 signal and to a sustained Drywell Pressure High signal.

See Chapter 14 for a thorough discussion of preoperational testing on the GDCS.

Reliability Test and Inspections

No system component tests are conducted during plant operation. The trip logic units of each logic division and the time delay units for squib actuation may be tested during plant operation. The trip logic units are continuously self-tested. See Table 6.3-3 for the components to be tested, the type of test to be conducted, and component alignment. The only valves directly operated for testing are the normally-closed isolation valves on the test lines. Flow through the system test lines is used to open and close the GDCS check valves and to show that there is no obstruction of the RPV nozzles. Valve realignment following test is controlled administratively.

Pre-operational and periodic testing of the igniters and booster subassemblies of the GDCS squib valves are performed. These tests quantify, measure, or detect any degradation, and provide assurance that the GDCS squib valves will perform their safety-related function.

~~To confirm functional capability, t~~The ignit~~o~~ers and booster subassemblies of the GDCS squib valves are removed from the valves and tested in sequential sets. ~~during the refueling and maintenance outage at the end of each plant operating cycle.~~ The initial qualified life for the boosters and ignitors is four years. Replacement is done without ~~any~~ opening of the reactor coolant pressure boundary~~RCPB~~. Subsequently in the laboratory, the removed charges are tested to confirm end of life capability to function upon demand. Periodic testing is conducted during the refueling and maintenance outage at the end of each plant operating cycle. Pre-operational testing is conducted prior to initial plant start up.